

REGULAR ORIGINAL FILING

Application Based on

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**PROGRAMMABLE NON-VOLATILE MEMORY FOR CMOS  
SENSORS**

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## **PROGRAMMABLE NON-VOLATILE MEMORY FOR CMOS SENSORS**

### **FIELD OF THE INVENTION**

The present invention relates to memory for image sensors and, more  
5 particularly, to such image sensors having re-programmable or one-time  
programmable memory connected to and on the same substrate as the sensor for  
providing minimal time delays upon startup and efficient power consumption.

### **BACKGROUND OF THE INVENTION**

10 In prior art digital imaging devices, such as cameras, the imaging device contains an image sensor or imager for capturing the image. With a CMOS imager, current state of the art requires that all imager variables be established at camera startup. Typically, at power-up, the imager is reset to load the mask programmed default variables from read only memory (ROM) into the  
15 active variable registers. Then, a portion of these default variables is modified, typically, by a microprocessor that serially loads them into the imager. These microprocessor-loaded, static variables define the variables for the specific application of the imager.

Although the currently known and utilized apparatus and method  
20 for digital imaging startup is satisfactory, it includes drawbacks. All deviations from the default variables must be serially loaded into the CMOS imager. In addition, some imaging devices enable the microprocessor to read back the active registers and compare the loaded values with desired values. This creates time delays and consumes more power.

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### **SUMMARY OF THE INVENTION**

The present invention is directed to overcoming one or more of the problems set forth above. Briefly summarized, according to one aspect of the present invention, the invention resides in an image capture device for capturing  
30 an image comprising (a) a substrate (b) an image sensor on the substrate for receiving incident light; (c) non-volatile, programmable memory on the substrate for storing predetermined variables that are loaded into predetermined circuitry

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used to manage the image sensor upon startup. This programmable memory is integrated on the same substrate as the imager and the predetermined circuitry.

- The above and other objects of the present invention will become more apparent when taken in conjunction with the following description and
- 5 drawings wherein identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

### **Advantages**

- The present invention includes the advantage of reducing camera
- 10 power consumption and reducing the time to first image capture by not having to serially program the static variables.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

- Fig. 1 is a schematic diagram of the one-time or re-programmable
- 15 memory and imaging sensor of the present invention. The one-time or re-programmable memory is integrated with the imager on the same substrate.

### **DETAILED DESCRIPTION OF THE INVENTION**

Referring to Fig. 1, there is shown a substrate 5 containing below-described, electrical components integrally disposed on the substrate 5, as described in detail hereinbelow. A digital image capture device 10 of the present invention having an image sensor 20 for capturing incident light that is stored in electronic form. As is well known in the art, the sensor 20 includes a plurality of pixels 30 positioned in an array which individually capture a portion of the incident light, and an active register 35 for storing variable used during image capture. These variables establish the operating parameters for the imager. Programmable memory 40 is integrated on the substrate and electrically connected to the image sensor 20 for passing predetermined variables to active register 35 of the image sensor 20 upon startup. This programmable memory 40 is non-volatile which means it holds its programmed contents when power is removed. These variables are determined according to the specific use for the image capture device 10, and are input after determining the specific use for the image capture device

10. This input can be a one-time operation either at the imager manufacturer or at the device (camera) manufacturer. For example, a typical image capture device 10 may be either a digital camera, video camera, scanner, a high-speed image capture device and the like. As will be readily recognized by those skilled in the art, each type of image capture device 10 requires unique variable loaded into the registers 35 of the image capture device 10 based on the application. As used herein, programmable memory 40 means one-time programmable memory or re-programmable memory, such as either an electronic programmable read only memory (EPROM), FLASH programmable, non-volatile memory or programmable read only memory (PROM).

A microprocessor 50 is also electrically connected to the registers 50 for directing control of the digital image capture device such as modifying variables of the registers 35, serially loading these variables into registers 35 and the like. This microprocessor 50 can optionally be used to program the non-volatile memory 40 in lieu of using one-time programming at the factory. The programmable path 55 can be made bi-directional such that the microprocessor 50 can read back the contents of the non-volatile memory 40. This enables a compare function in the microprocessor 50 to verify the contents of the non-volatile memory 40.

Typical camera operation from startup for the present invention could be as follows. It is given that the one-time programmable memory or re-programmable memory contains the correct static variables for the application. For example, those serially loaded from the microprocessor 50 or previously factory programmed. At power up, the camera electronics assert and remove the reset. This initializes the active variable registers to the correct values for the application from the non-volatile programmable memory 40. The microprocessor 50 (or other device) modifies the active variable registers 35 (a much smaller quantity than in the prior art) to adjust to the immediate scene to be captured.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

**PARTS LIST**

- 10 image capture device
- 20 sensor
- 30 pixels
- 35 active register
- 40 programmable memory
- 50 active register
- 55 path